Dual-Fuel Combustion Turbine Provides Reliable Power to U.S. Navy Submarine Base New London in Groton, Connecticut

Combined heat and power project provides reliable power at reduced cost

Combined Heat and Power

Case Study

Overview

In keeping with a long-standing tradition of running Base utilities as a business, the U.S. Navy Submarine Base New London installed a dual-fuel combustion turbine with a heat recovery boiler. The 5-megawatt (MW) gas- and oil-fired combustion turbine sits within the Lower Base area, just off the shores of the Thames River. The U.S. Navy owns, operates, and maintains the combined heat and power (CHP) plant, which provides power to the Navy's nuclear submarines when they are in port and to the Navy's training facilities at the Submarine Base. Heat recovered from the turbine is used to produce steam for use in Base housing, medical facilities, and laundries. In FY00, the Navy estimates that it will save over $500,000 per year as a result of the combined heat and power unit.

"The ability to peak shave and load curtail provided by the combined heat and power system has proven invaluable."

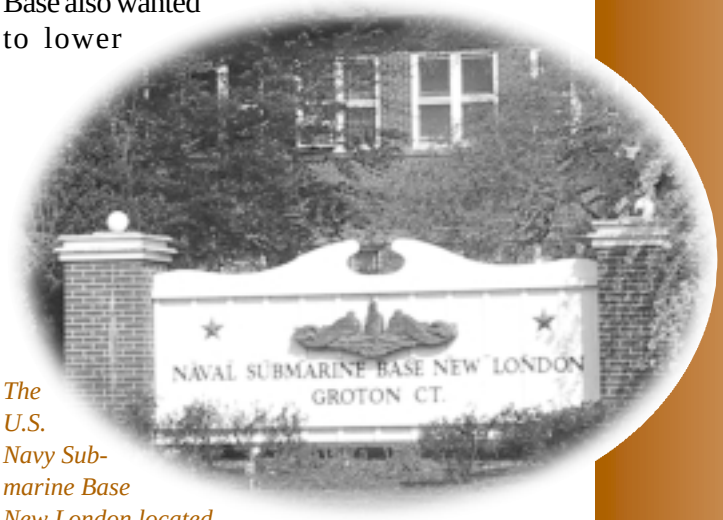
—Herbert Cummings, Director of Utilities, U.S. Navy Submarine Base New London

Background

The U.S. Navy Submarine Base New London is the Navy's first submarine base, with its first submarines arriving in 1915. Today, the Base serves as the training ground for all submariners in the Navy. The Base is home to several attack submarines and the Navy's nuclear research deep submersible NR-1. The Base is also home to the Navy's Submarine School and the Naval Submarine Support Facility. Submarine Base New London provides housing and support facilities for 8,000 military personnel and 1,000 civilian employees.

Submarine Base New London is responsible for approximately 20% of the total electric load in Groton, Connecticut, with peak loads reaching between 25 and 26 MW. The Base electric load is very dynamic. Total electric load at the Base is highly dependent on the number of submarines in port. The Base's utility contract calls for the electric load to remain under 17 MW or face a penalty of $12.06 per kW. Recently, a single incident involving new switchgear led to inadvertent use of utility power for the whole Base, generating a one-time charge of $605,000. On the other hand, the Navy also calls for them to curtail their load when requested by the utility and receive 18 cents per kWh for that curtailment. Average annual energy costs for the 500-acre facility are $6 million for electricity, $3.2 million for natural gas, and $250,000 for fuel oil. In addition, the Base generates enough electricity to meet around 30% of the 100,000 megawatt-hours consumed each year.

The Base faced high local electric utility demand rates, aging onsite generation facilities, and a limited amount of space for onsite generation. The Base also wanted to lower



The U.S. Navy Submarine Base New London located on the Thames River near Groton, Connecticut, serves as the training ground for all submariners.

The 5-MW Taurus 60 from Solar Turbines, Inc. logged 18,000 hours of operation over its first 3 years. Installation went smoothly, thanks to the contractor.

the overall costs of operations. Realizing that they had to replace the old systems, but also recognizing that they had a year-round water heating load (based on the number of personnel stationed at the Base), the concept of a high-efficiency, high-reliability combined heat and power plant seemed to be an ideal solution.

Project Summary

Requirements for the Base CHP system included:

- Support a year-round heat load for personnel and processes
- Ability to separate generation systems to allow for main plant shutdown
- Quick startup capability to accommodate dynamic load changes
- Ability to use alternative fuels to control costs
- Be a relatively compact system because of space limitations
- Meet stringent environmental permitting requirements.

A preliminary study indicated that a dual-fuel combustion turbine with a heat recovery boiler best fit the combination of economics, flexibility, and space available at the Base. The final selection for the CHP plant was a 5-MW Taurus 60 from Solar Turbines, Inc. The combustion turbine includes water-injected NO_x control and a CO catalyst to reduce emissions, and a 50,000 lb/hr, 300 psi boiler with duct burner. A dual exhaust system also allows for boiler bypass, if necessary.

The installation was completed in December 1997. The Base reports installation went extremely smoothly, a result of good contract oversight and an excellent contractor. The system logged 18,000 hours of relatively trouble-free operation over its first 3 years. The system does experience some difficulty in starting when switching to an alternative fuel after long periods of operation. However, the use of alternative fuels plays such an important role in reducing overall fuel costs at the Base, this difficulty is considered acceptable.

The control room monitors the operating conditions of the combustion turbine and heat recovery system.

Heat recovered from the combustion turbine is utilized in a 50,000 pound per hour boiler.

Benefits

The biggest benefit Submarine Base New London has seen from the CHP system is that they can now supply some of the widely-varying electrical loads of the Base at a lower cost than the local utility. The benefit of low-cost hot water just adds to the usefulness of this system. From the "public works as a business" point of view, the ability to peak shave and load curtail provided by the system has proven invaluable.

Lessons Learned

The Base recommends that any site considering a CHP system take the following steps:

- Carefully determine utility loads to determine which type of cogeneration system best fits the needs of your site. There are lots of systems out there, and they all have different characteristics that make them more or less useful in your specific situation.
- Consult with your local utility to investigate incentives that may make or break the project. Project dollars are tight throughout the Federal sector and every little bit of incentive funding can help. Also investigate the possibility of interruptible rates or load curtailment with your utility.
- Ensure the system is multi-fuel capable. This capability not only provides a backup in times of spot fuel shortage, but also provides the ability to save considerable energy dollars.
- Consult with your State's Department of Environmental Protection to ensure compliance with emission regulations.

The capability for multiple fuels has been exercised extensively by the Base in their quest to run their utilities like a business. Submarine Base New London was named one of the military's FY98 Cost Avoidance Success Stories for saving $1.2 million in natural gas costs and again in FY99 for saving over $2 million in gas costs. The Base accomplishes this by carefully predicting their natural gas needs, contracting for that amount of gas through the DOD Direct Supply Natural Gas (DSNG) Program managed by the Defense Energy Support Center (DESC), and then using the dual-fuel capability of their system to avoid paying high prices for spot-market natural gas. The Base also received a 1998 Federal Energy and Water Management Award. The CHP plant was specifically noted in that award.

Looking Ahead

The CHP system has been a valuable enough addition to Submarine Base New London that the Base's Energy Board of Directors is considering the addition of another 10-MW combustion turbine CHP plant. The existence of an "energy board of directors" is an indication of the importance the Base puts on energy usage and the concept of "operating the Base utilities as a business."

For More Information

FEMP Help Desk

(800) 363-3732
International callers please use
(703) 287-8391
Web site: www.eren.doe.gov/femp

General Contacts

Shawn Herrera
Program Manager
Federal Energy Management Program
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585
Phone: (202) 586-1511
Fax: (202) 586-3000
shawn.herrera@ee.doe.gov

Merrill Smith
Program Manager
Office of Distributed Energy Resources
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585
Phone: (202) 586-3646
Fax: (202) 586-1568
merrill.smith@ee.doe.gov

Site Contacts

Herbert D. Cummings
Director of Utilities
U.S. Navy
Submarine Base New London
Box 400, Code 860
Groton, CT 06349-5400
Phone: (860) 694-4610
Fax: (860) 694-4345
cummingsh@subasenlon.navy.mil

Produced for the U.S. Department of Energy (DOE) by the Pacific Northwest National Laboratory

PNNL-SA-35385

February 2002